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ON THE SOUTH AFRICAN GORGONOPSIAN REPTILES PRESERVED IN THE AMERICAN MUSEUM OF NATURAL HISTORY

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On the whole, the gorgonopsians are much better represented in the Broom Collection than the therocephalians. There are seventeen specimens, which represent eight gorgonopsian genera. There are: one form from the *Tapinocephalus* zone, four from the *Endothiodon* zone and three from the *Cistecephalus* zone. There are eight fairly complete skulls, the best being a good skull, which is the second known specimen of Owen's original genus *Gorgonops;* one good lower jaw, which shows the whole structure of the gorgonopsian mandible; eight poor snouts and some parts of the postcranial skeleton in association with some of the skulls.

From the *Tapinocephalus* zone there is only one specimen.

Eriphostoma microdon Broom

BROOM, R., 1911, Proc. Zool. Soc., p. 1078.
BROOM, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 117.
BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 53.
TYPE.—Amer. Mus. No. 5524, Fraserburg Road; *Tapinocephalus* zone.

This specimen consists of two weathered portions of a fairly small skull (premaxilla to basioccipital—?110 mm.) and these are not in contact; the dorsal bones are weathered away; the greater part of both sides is also missing. The symphysis of the lower jaw is high and square; the snout is high, but narrow; the orbit appears to have been fairly small. In the right premaxilla, parts of the crowns of four incisors are preserved; on the third tooth a serrated posterior border is visible. One slender canine is, in part, preserved, and, immediately anterior to it is the tip of a replacing canine in the process of erupt on. On the right side the incisor series measures 11 mm.; the diastema, to the functional canine, measures 13 mm. On the left side the crown of one canine is seen; this is followed by a diastema of 11 mm.; posterior to the diastema, only the remains of two closely-set, slender molars are preserved. As the

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septomaxilla is not preserved, Broom's figure (1932) showing that element is hypothetical. Since the intertemporal region is lost, it is not possible to state with certainty whether *Eriphostoma* is a gorgonopsian or a therocephalian; the only evidence, which is not conclusive, that this form is a gorgonopsian is afforded by the nature of the mandibular symphysis; this is upright, whereas in the therocephalians it generally slants backwards.

From the *Endothiodon* zone there are specimens of four genera—*Gorgonops*, *Aelurosaurus*, *Aloposaurus* and *Scymnognathus*.

Gorgonops torvus Owen

(Figures 1–3)

Owen, R., 1876, Cat. Foss. Rept. So. Afr., p. 27.
Watson, D. M. S., 1914, Proc. Zool. Soc., p. 1031.
Broom, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 126.
Watson, D. M. S., 1921, Proc. Zool. Soc., p. 39.
Broom, R., 1932, Mammal-like Reptiles of South Africa, p. 113.
Boonstra, L. D., 1934, Ann. So. Afr. Mus., p. 181.
Referred Specimen.—Amer. Mus. No. 5515, Beaufort West; *Endothiodon* zone.

This specimen is a good skull, which lacks only the lower jaws and both quadrates and quadrato-jugals. It shows many more details of the cranial structure than does the type in the British Museum. In view of the full descriptions by Watson and myself based on the type, this account is purely supplementary.

After removing the bulk of the matrix with a chisel, a long process of alternately polishing and etching with dilute acid has revealed the majority of the sutures—some of them being beautifully shown.

On the dorsal surface the following features, not very well shown in the type, have been determined: the limits of the large preparietal are beautifully exposed; the distinctive parietal crests are shown in the accompanying figures; the infratemporal bar is preserved, and it is now certain that the temporal openings are of moderate size; in between the parietal crests, the occiput slopes gently backwards and downwards; the septomaxilla is large and its foramen opens into the posterior corner of a fairly large hollow.

In ventral view, the relations of the palatines, pterygoids and ectopterygoids are clearly exposed, and they show that my interpretation of their structure in the type was correct and my criticism of Watson's (1921) interpretation justified. The dentigerous ridges on the palatines and the pterygoids are very imperfectly preserved in the type; here they are well shown; these ridges differ from the condition shown in all

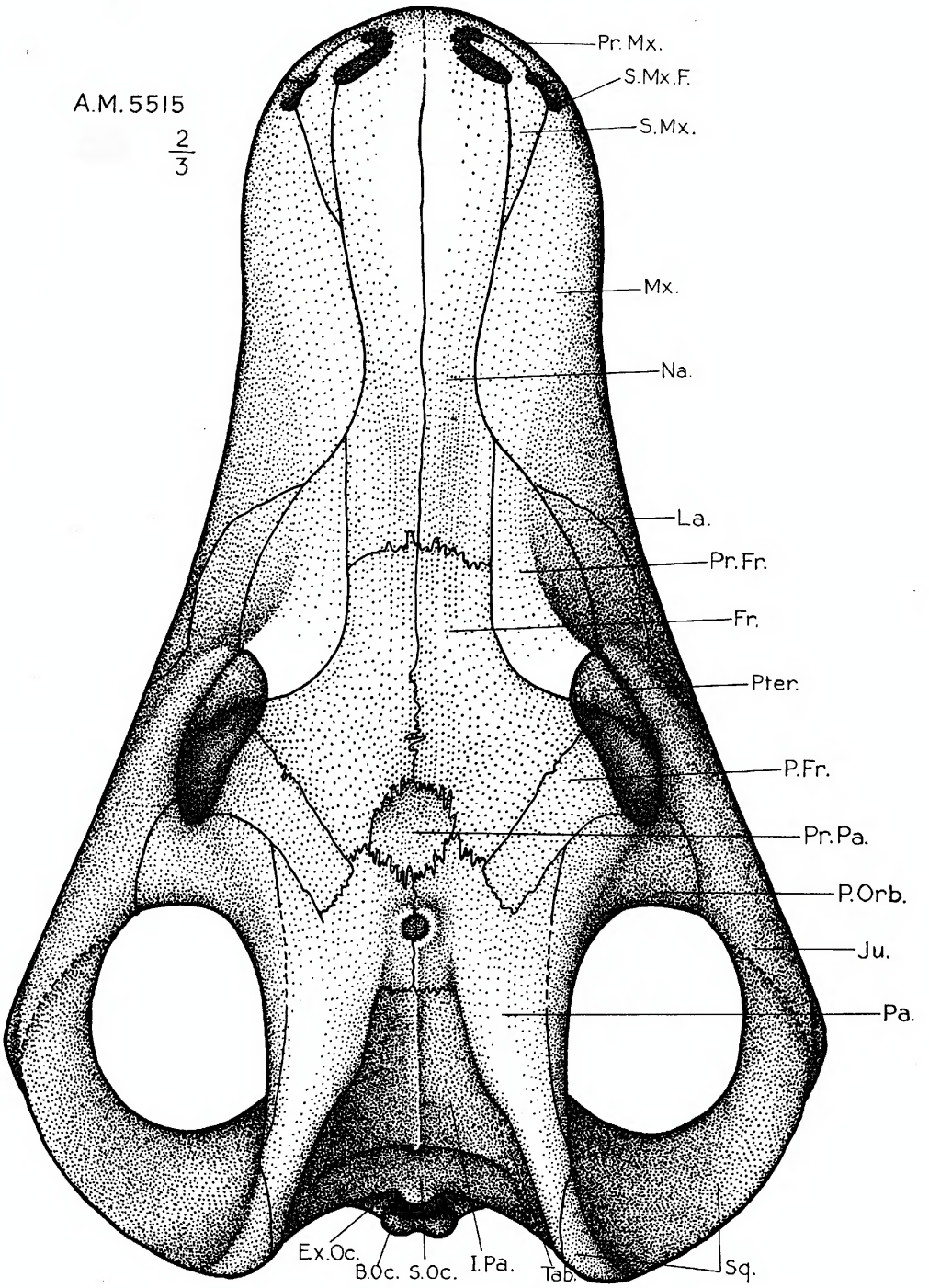

Fig. 1. *Gorgonops torvus*. Amer. Mus. No. 5515. $\times\frac{2}{3}$. Dorsal view of the skull.

B.Oc.	=basioccipital.	P.Orb.	=postorbital.
Ex.Oc.	=exoccipital.	Pr.Fr.	=prefrontal.
Fr.	=frontal.	Pr.Mx.	=premaxilla.
I.Pa.	=interparietal	Pr.Pa.	=preparietal.
Ju.	=jugal.	Pter.	=pterygoid.
La.	=lacrymal.	S.Mx.	=septomaxilla.
Mx.	=maxilla.	S.Mx.F.	=septomaxillary foramen.
Na.	=nasal.	S.Oc.	=supraoccipital.
Pa.	=parietal	Sq.	=squamosal.
P.Fr.	=postfrontal	Tab.	=tabular.

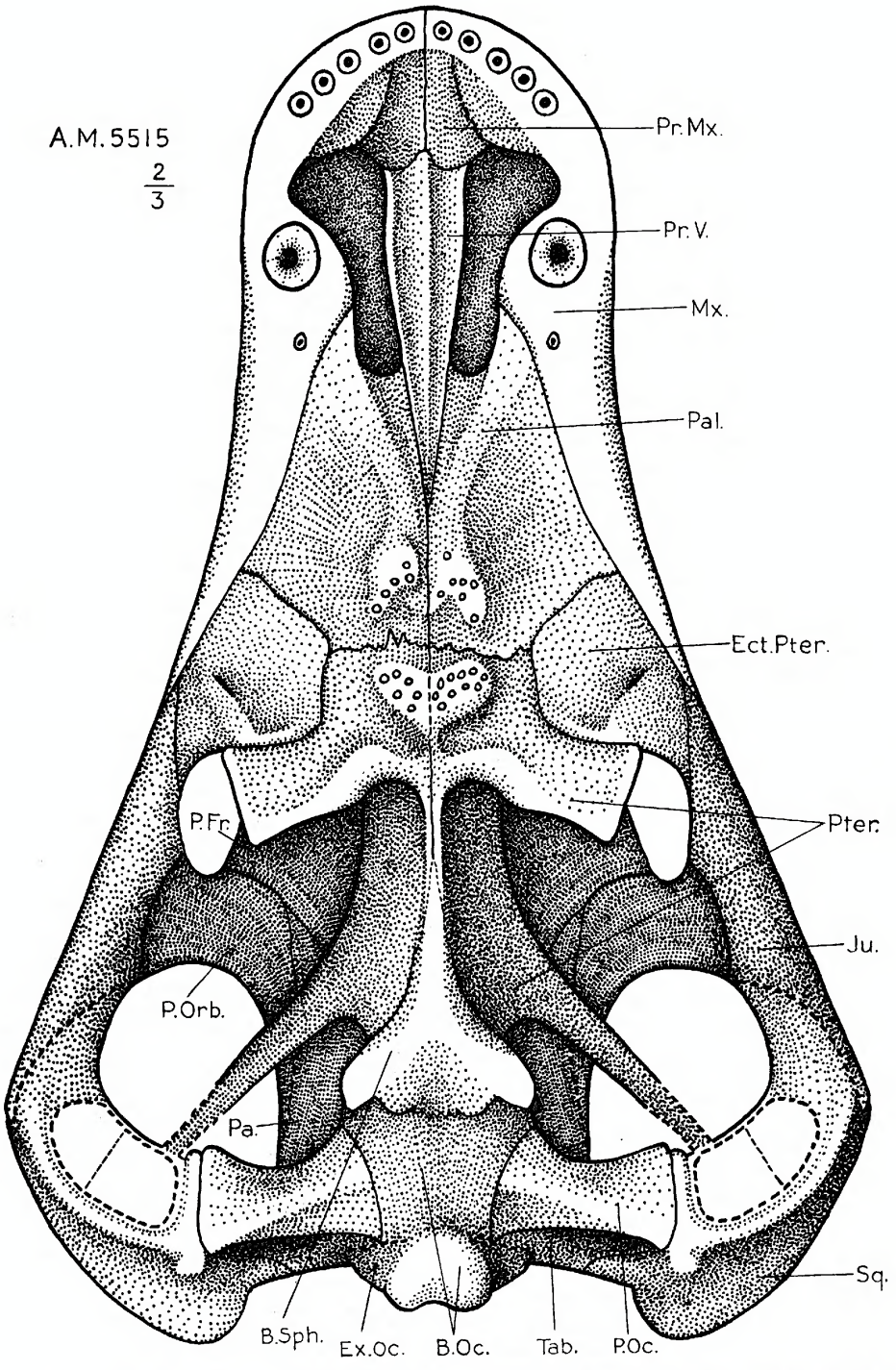

Fig. 2. *Gorgonops torvus.* Amer. Mus. No. 5515. $\times\frac{2}{3}$. Ventral view of the skull.

B.Sph. =basisphenoid.
Ect.Pter. =ectopterygoid.
Pal. =palatine.
P.Oc. =paroccipital.
Pr.V. =prevomer.
Other lettering as in Fig. 1.

of the gorgonopsians that I have examined, in that the part on the pterygoid is widely separated from that on the palatine, and in their distinctive shape, as shown in the accompanying figure. Unfortunately, the basicranium had been damaged before fossilization commenced; the structures that can be determined are incorporated in the figure of the ventral surface of the skull.

As in the type, the root of only one small molar can be seen; *Gorgonops* has been considered to be a fairly primitive type of gorgonop-

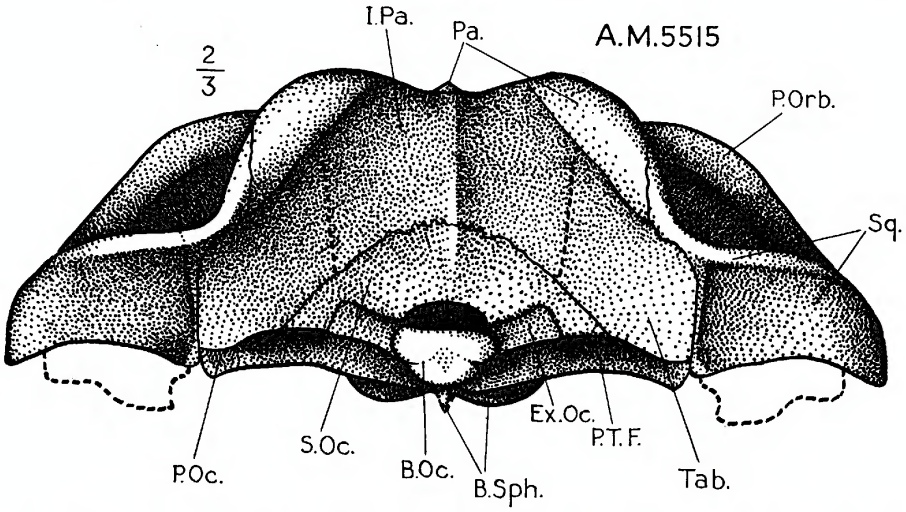

Fig. 3. *Gorgonops torvus*. Amer. Mus. No. 5515. $\times\frac{2}{3}$. Occipital view of the skull.
P.T.F. =posttemporal fenestra.
Other lettering as in Figs. 1 and 2.

sian; the reduction of the molars is a fact that can hardly be reconciled with this view; the specialized nature of the palatal dentigerous ridges is also a feature which one would not expect in a primitive gorgonopsian.

Aelurosaurus felinus Owen

Owen, R., 1881, Quar. Journ. Geol. Soc., p. 261.
Lydekker, R., 1890, Cat. Foss. Rept. Amph., p. 75.
Seeley, H. G., 1895, Phil. Trans. Roy. Soc. London, p. 991.
Broom, R., 1910, Trans. Roy. Soc. So. Afr., p. 23.
Broom, R., 1911, Proc. Zool. Soc., p. 1077.
Broom, R., 1912, Proc. Zool. Soc., p. 863.
Watson, D. M. S., 1921, Proc. Zool. Soc., p. 86.
Broom, R., 1931, Rec. Albany Mus., p. 165.
Broom, R., 1932, Mammal-like Reptiles of South Africa, p. 118.
Boonstra, L. D., 1934, Ann. So. Afr. Mus., p. 189.

TYPE.—Amer. Mus. No. 5514. *Aelurosaurus breviceps*, Beaufort West, *Endothiodon* zone.

TYPE.—Amer. Mus. No. 5506. *Aelurosaurus striatidens*, Kuilspoort, *Endothiodon* zone.

TYPE.—Amer. Mus. No. 5504. *Aelurosaurus tenuirostris*, Kuilspoort, *Endothiodon* zone.

TYPE.—Amer. Mus. No. 5528. *Aelurosaurus whaitsi*, Beaufort West, *Endothiodon* zone.

REFERRED SPECIMEN.—Amer. Mus. No. 5607. ?*Aelurosaurus felinus*, Beaufort West, *Endothiodon* zone.

All these specimens consist of more or less imperfect snouts, which, I believe, show no valid characters which would distinguish them from Owen's original species. Amer. Mus. No. 5514 is a good anterior part of a small gorgonopsian skull, of which Broom has given a correct lateral view (1932). The dental formula is: I-5, C-1, M-4. All the characters shown are as in *A. felinus;* the fact that it represents a slightly larger animal is no justification, without corroborative evidence, for the creation of a distinct species.

Amer. Mus. No. 5506 is a bad small snout showing only some features of the dentition; on each premaxilla there are five incisors; in the maxilla, one long slender canine, oval in cross-section, the crowns of two and the roots of another two molars are present. The dental formula, I-5, C-1, M-4, is thus as in Owen's *A. felinus*. On the canine and incisors, however, vertical striae are preserved, and on all the teeth faint indications of serrations on the posterior borders are visible. In Owen's type, these striae have not been determined with certainty. Without some other supporting evidence, the smaller size of this animal and the striae on the teeth cannot be accepted as sufficient proof of specific distinction from *A. felinus*.

Amer. Mus. No. 5504 consists of a weathered, laterally compressed snout. On the right side, there are remnants of four incisors, the fifth being lost; one long canine, oval in cross-section; and the roots of two molars. On the left side, there are remains of five incisors, the fifth being small; one canine and no molars. As Broom himself suggested that some of the molars may be lost through old age, there are no characters present which would preclude this specimen being included in Owen's *Aelurosaurus felinus*.

Amer. Mus. No. 5528 consists of a fragment of the left premaxilla and maxilla, part of the right maxilla, a fragment of the symphysial part of the right dentary and a little fragment of the roof of the skull.

In the dentary, the roots of one canine, oval in cross-section, and four closely packed incisors are visible; the symphysis is high and forms

a right angle with the ramus; no molars are preserved. In the left upper jaw there are: one canine, oval in cross-section and with its posterior edge serrated; the roots of five incisors; no molars are preserved.

In the topotype, Amer. Mus. No. 5513, a weathered snout shows that the dental formula is, I-5, C-1, M-5; all the teeth have serrated posterior borders.

The measurements of these two specimens are as for Owen's *A. felinus*, and, although there is one more molar, I think that we may well regard *A. whaitsi* as a synonym of *A. felinus* until better preserved specimens prove the contrary.

In Amer. Mus. No. 5607 parts of a small skeleton have been referred by Broom to ?*Aelurosaurus felinus*. The right femur of this specimen has been figured by Williston and by Gregory under this name. In no case is there anything of the postcranial skeleton preserved in association with any skull of *Aelurosaurus*, and as this skeletal material is not associated with any identifiable cranial material, there is no evidence whatsoever that we are dealing with the genus *Aelurosaurus*. This specimen consists of the imperfect pelvis, which shows that the elements were loosely connected; the ilium has a posterior and an anterior expansion; the pubis has a long anterior process and a large pubic foramen; the ischium has a fairly long posterior extent; the acetabulum is large—the main part being formed by the ilium; there are two good femora, tibiae and fibulae; a fair left humerus, with its distal end, however, not in contact; the deltoid crest is fairly strong.

Aloposaurus gracilis Broom

Broom, R., 1910, Bull. Amer. Mus. Nat. Hist., XXVIII, Art. xx, p. 208.
Broom, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 124.
Broom, R., 1932, Mammal-like Reptiles of South Africa, p. 126.
Type.—Amer. Mus. No. 5317, Kuilspoort; *Endothiodon* zone.

This specimen consists of a complete skull, which, however, has been badly crushed and fractured; the structure of the outer surface can, nevertheless, be determined. Broom's lateral view probably shows the true shape of the skull; his identification of some of the elements is at fault; a distinct postfrontal is present; the frontal has a long entry on to the supraorbital border; from the pineal foramen the occiput slopes gently to the condyle; the median keel of the basisphenoid is very deep and the tubera are laterally directed, but are rounded. In 1910, Broom gave the dental formula $\frac{\text{I-5, C-1, M-?5}}{\text{I-4. C-1, M-?}}$, but he figured I-5, C-2, M-6; in 1915, the formula was, I-5, C-1, M-?6 and, in 1932, I-5, C-1, M-6.

I find it to be $\frac{\text{I-5, C-1, M-4+1?}}{\text{I-4, C-1, M?}}$. There are vertical striae on the incisors; in the left maxilla, there is a replacing canine anterior to the functional one; the crowns of four small molars are preserved, but, posterior to the first, there is a space, which may have housed another tooth; in the right maxilla one canine root is visible, and, by grinding, four molar roots have been exposed; posterior to the first a space is again visible.

Scymnognathus whaitsi Broom

Broom, R., 1912, Proc. Zool. Soc., p. 861.
Watson, D. M. S., 1921, Proc. Zool. Soc., p. 44.
Broom, R., 1932, Mammal-like Reptiles of South Africa, p. 116.
Boonstra, L. D., 1934, Ann. So. Afr. Mus., p. 183.
Type.—Amer. Mus. No. 5530, Beaufort West Commonage; *Endothiodon* zone.

This genus was founded on three crushed and weathered skulls. The type specimen lacks the snout. The dental formula is, I-?, C-1, M-4. Watson's figures, based on a specimen in the British Museum, are more nearly correct than those of Broom; the precanine step in the dentigerous border is, however, not so pronounced as figured by Watson; the preparietal is long and oval as Watson figured it; the frontal-prefrontal suture, not figured by Watson, is as given by Broom.

In the topotype, Amer. Mus. No. 5531, the dental formula is, I-5, C-1, M-4; the relations of the septomaxilla and the structure of the occiput are as figured by Watson for the British Museum specimen.

In the other topotype, Amer. Mus. No. 5544, the large preparietal is well shown.

A specimen, Amer. Mus. No. 5563, shows a good atlas and axis, in which the atlantal arch, intercentrum and the greatly elongated axial spine are well shown.

In the collection there is also a weathered, though complete, humerus, which shows a large entepicondylar foramen; a snout, Amer. Mus. No. 5546, is unidentifiable, and of a large number of fragments of the postcranial skeleton very little can be determined.

From the *Cistecephalus* zone there are specimens of three genera preserved in the collection: *Delphaciognathus*, *Ictidorhinus* and *Lycaenoides*.

Delphaciognathus paucidens Broom

(Figure 4)

Broom, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. II, p. 125.
Broom, R., 1932, Mammal-like Reptiles of South Africa, p. 126.
Type.—Amer. Mus. No. 5562, Wittekop, Nuweveld; *Cistecephalus* zone.

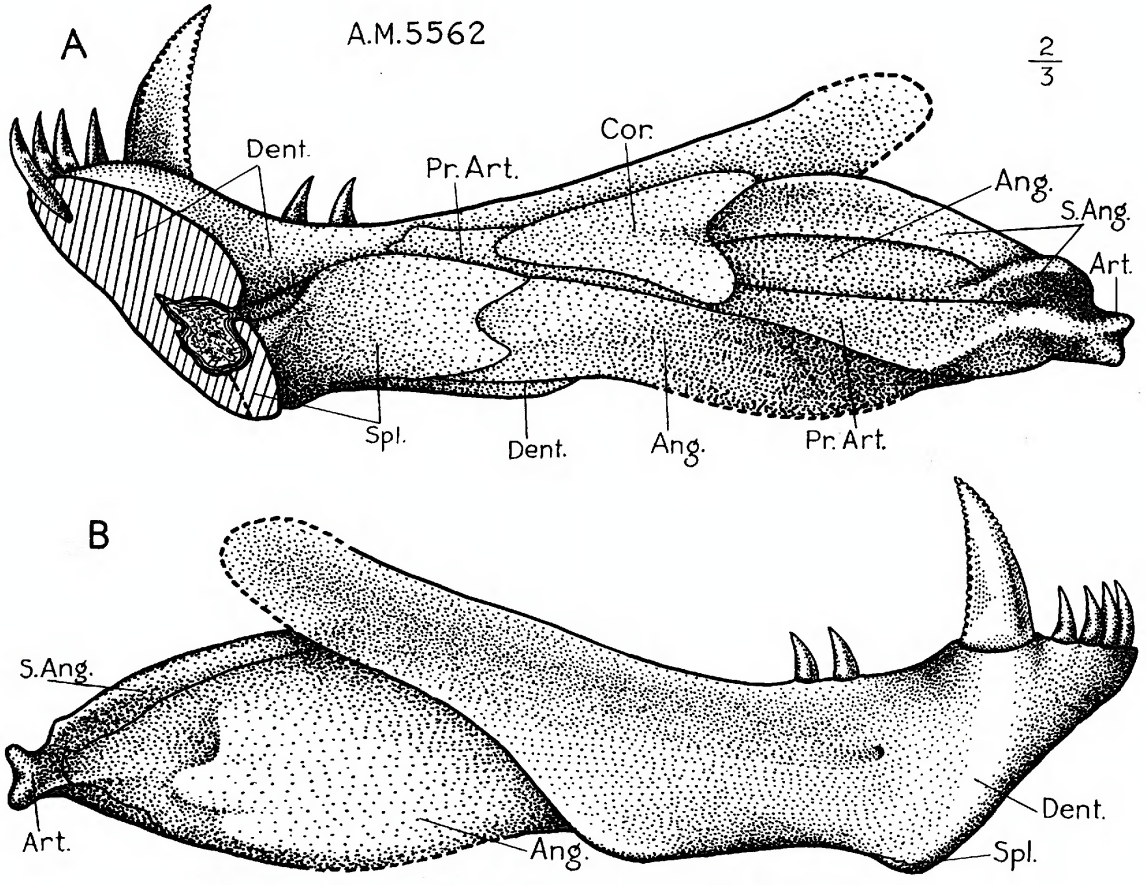

Fig. 4. *Delphaciognathus paucidens.* Amer. Mus. No. 5562. $\times\frac{2}{3}$.

A. Inner view of the right mandible.

B. Outer view of the right mandible.

Ang. =angular.
Art. =articular.
Cor. =coronoid.
Dent. =dentary.
Pr.Art. =prearticular.
S.Ang. =surangular.
Spl. =splenial.

This species was founded by Broom on a well-preserved lower jaw, which consists of a complete right ramus and the anterior half of the left ramus. The only character mentioned by Broom to justify the creation of a new genus is the presence of two lower molars. As practically nothing is known of the lower molars of the majority of gorgonopsians, this single character seems to be a very insecure basis for generic distinction. In *Aelurognathus microdon* there are also two lower molars. A re-examination of the lower molars of the well established types will no doubt indicate the correct synonymy.

I have had the mandible cut through at the symphysis in order to determine the relations of the dentary and splenial and to be able to expose the anterior third of the inner surface of the jaw.

The splenial is a relatively small bone, forming the anterior third of the inner surface and the ventral corner of the mentum.

The dentary is large; it forms a strong, fairly upright symphysis, but presumably only a moderately strong coronoid process; it carried four medium-sized incisors, which occupy 12 mm.; the space between the last incisor and the canine measures 4 mm.; the canine is fairly large —it is compressed from side to side and both its borders are serrated; the serrations on the anterior side lie somewhat medially of the anterior border; behind the canine there is a diastema of 19 mm.; the two small molars occupy a space of 12 mm.

The prearticular is a long bone, which commences just behind the molars and continues backward to form the anterior border of the articulatory surface.

The coronoid is a flat sheet of bone, applied to the inner surface of the dentary and prearticular.

The surangular has the usual beam-shape and transmits the pressure on the dentary to the articular.

The angular is a large flat bone, forming the greater part of the posterior third of the outer surface; it does not carry the ridges, which form the distinctive pattern on the outer surface of the therocephalian angular.

The articular is small; it forms the main part of the articulatory surface; it is firmly clasped by the angular, prearticular and surangular, which thus form the bridge between the resistance on the dentary and the fulcrum situated on the articular.

Ictidorhinus martinsi Broom

(Figures 5–6)

Broom, R., 1913, Bull. Amer. Mus. Nat. Hist., XXXII, Art. xxxvii, p. 560.

Broom, R., 1914, Phil. Trans. Roy. Soc. London, p. 46.

Broom, R., 1932, Mammal-like Reptiles of South Africa, p. 136.

Type.—Amer. Mus. No. 5526, Wilgebosch near New Bethesda; *Cistecephalus* zone.

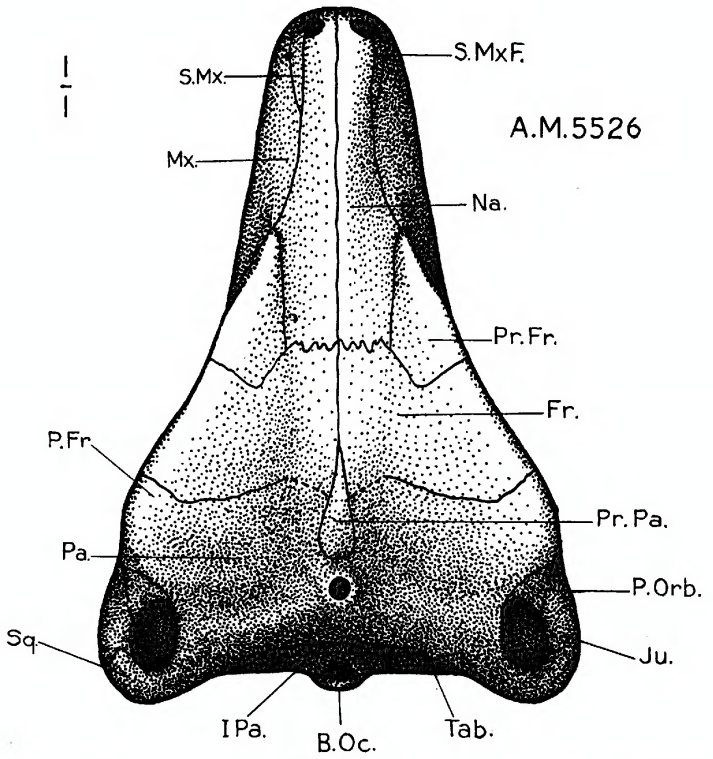

Fig. 5. *Ictidorhinus martinsi.* Amer. Mus. No. 5526. ×1. Dorsal view of the skull, with the distortion corrected.

Lettering as in Figs. 1 and 2.

This remarkable little skull is clearly that of an aberrant branch of the gorgonopsians. The very great intertemporal width and the development of a thickened supraorbital ridge are reminiscent of the similar, but much more pronounced, development of these parts of the skull in the other aberrant gorgonopsian, *Burnetia mirabilis.* Broom's original figure is very misleading; his 1932 reconstruction conveys a much better idea, but it lacks details of the structure.

The dental formula is, I-4, C-1, M-4 or 5. Immediately behind the canine is a tooth which forms the first of a series of five teeth; it is, however, possible that the first tooth is not a molar, but really a replacing canine.

The snout is narrow and high, with the nostrils practically terminal; the interorbital width is very great (30 mm. across the frontals and 55 mm. across the postfrontals); the intertemporal width, although less than the greatest interorbital width, is likewise great (43 mm.); the orbits are large and somewhat longer than high; the temporal fossae are remarkably small.

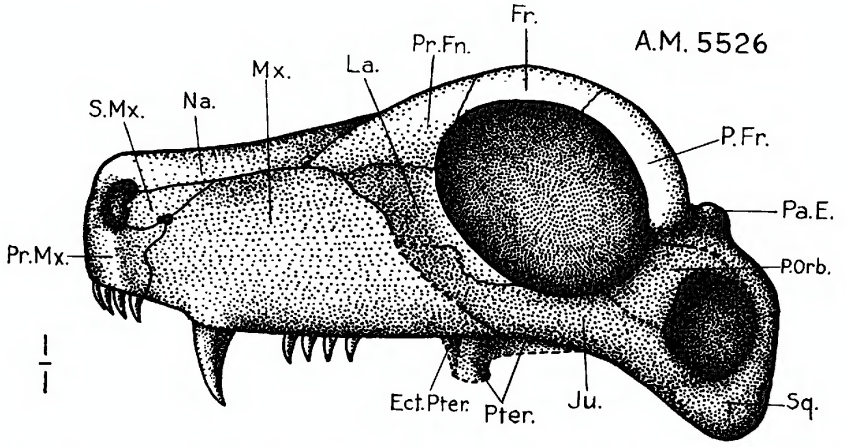

Fig. 6. *Ictidorhinus martinsi*. Amer. Mus. No. 5526. ×1. Lateral view of the skull, with the distortion corrected.

Pa.E. =eminence on the parietal, on which the pineal foramen opens.
Other lettering as in Figs. 1 and 2.

The strong supraorbital ridge is formed mainly by the prefrontal and the frontal; the preparietal is relatively large and is triangular in shape; the parietal is a broad element; there is a distinct tabular; the supraoccipital, if it stretches to the tabular, would be very broad; the maxilla is high. The pineal foramen is large and is surrounded by a circular wall 3 mm. high; the posttemporal fenestrae are preserved as narrow slits above the paroccipitals.

Lycaenoides angusticeps Broom

Broom, R., 1913, Bull. Amer. Mus. Nat. Hist., XXXII, Art. xxxvii, p. 558.
Broom, R., 1915, Bull. Amer. Mus. Nat. Hist., XXV, Pt. ii, p. 127.
Broom, R., 1925, Rec. Albany Mus., p. 314.
Broom, R., 1930, Phil. Trans. Roy. Soc. London, p. 370.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 132.

TYPE.—Amer. Mus. No. 5537, Wilgebosch near New Bethesda; *Cistecephalus* zone.

This genus was founded on a complete skull; it is laterally compressed and was extensively sun-cracked before fossilization, so that the details of structure are not shown; Broom's figure of the lateral surface showing nearly all the sutures is thus mainly inferential; he has also drawn the skull with a strong dorsal curvature; the skull, however, shows no evidence of any dorso-ventral crushing and Broom's published photograph shows the true amount of curvature. The teeth are not well-preserved, but the dental formula appears to be, I-5, C-1, M-4.

The chief measurements are:

Premaxilla to the posterior corner of the squamosal	300 mm.
Premaxilla to the anterior orbital border	170 mm.
The total length of the dental series	50 mm.

"Scymnognathus minor" Broom

BROOM, R., 1913, Bull. Amer. Mus. Nat. Hist., XXXII, Art. XXXVII, p. 559.

BROOM, R., 1932, Mammal-like Reptiles of South Africa, p. 118.

TYPE.—Amer. Mus. No. 5535, New Bethesda; *Cistecephalus* zone.

The skull is somewhat weathered and laterally compressed; only the anterior part of the left side of the snout has been cleaned by grinding—the matrix being too hard for a chisel. On the left side, five long slender incisors are visible; a space of 13 mm. is followed by one long slender canine; a diastema of 21 mm. is followed by the roots of two molars, with sufficient space between them to house another two.

On the right side, I have exposed by grinding: five incisors, the fifth being small; one very long canine, with a crown length of 52 mm.; four small, closely packed molars, which decrease in size in posterior direction. The dental formula, I-5, C-1, M-4, is as in *Lycaenoides angusticeps;* the length from the premaxilla to the corner of the squamosal (270 mm.) is less than that of *Lycaenoides*, but there are no other characters which could be cited to prove this form distinct from *Lycaenoides*. I therefore propose that the name *Scymnognathus minor* be considered a synonym of *Lycaenoides angusticeps*.

SUMMARY

1. The second known skull of *Gorgonops* is figured in dorsal, ventral and occipital view and its structure described.

2. Reasons are advanced to show that the forms *Aelurosaurus breviceps*, *A. striatidens*, *A. tenuirostris* and *A. whaitsi* are synonymous with Owen's original *Aelurosaurus felinus*.

3. The lower jaw of the gorgonopsian, *Delphaciognathus*, is figured and fully described.

4. The skull of a very remarkable little gorgonopsian, *Ictidorhinus*, is figured and its affinities are discussed.

5. It is pointed out that there are no valid reasons for not regarding *Scymnognathus minor* as synonymous with *Lycaenoides angusticeps*.

In conclusion, my thanks are due to the officers of the American Museum for the facilities enjoyed in studying the above material. To the University of Stellenbosch I am indebted for a grant enabling me to do this work. The drawings are by my wife, Esmé E. Boonstra.